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**Vehicle door and assembling method as well as disassembling method  
for the same**

*cls A1 >*

The invention refers to a vehicle door with the characteristics of the preamble of Claim 1 as well as an assembling method for the same according to Claim 11 and a disassembling method for the same according to Claim 12. This may involve driver, passenger, rear side or rear doors as well as both pivoting and sliding doors, in which, therefore, pivoting or sliding hinges are used for opening, for example.

In conventional vehicle doors it is common to join a support element constituting the supporting structure to the outer panel by peripheral welding, flanging or glueing, and to install the vehicle door in this state, with or without functional parts, such as lock, hinges, window lifter and the like, already installed to the support element, to the door opening of the vehicle which is to be closed off. The connection takes place in the hinge area. The so-called setting of the door is an assembly process requiring considerable experience, since the door must sit precisely positioned in all three spatial coordinates. For instance, vehicle doors are supposed to have a uniform gap with respect to the chassis in the X and Z directions (longitudinal and vertical directions of the vehicle). In the Y direction (transverse direction of the vehicle), the out

surface of the door should be as flush as possible with the rest of the car body. Therefore, the positioning accuracy must be visually checked after a preliminary installation of the vehicle door in the body and the door must be realigned in the body if necessary. In case the equipping of the door with functional parts such as window lifters and the like takes place only after the setting of the door in the body is finished, the subsequent weight increase of the door and thus a possibly changing position of the door with respect to the body must be taken into account during the initial setting of the door. Installation work in case of repairs to the vehicle door is equally difficult.

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A corresponding vehicle of this class is already known from DE-A1-30 04 897 showing an outer panel element rigidly screwed together with a support element. Therefore, the entire adjusting work is to be made with the support element.

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## SUMMARY OF THE INVENTION

Proceeding from this, the invention is based on the object of achieving an easing of the perfectly fitted assembling for vehicle doors of this class.

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This problem is solved by a vehicle door with the characteristics of Claim 1 as well as the corresponding assembling method according to Claim 11 and the disassembling method according to Claim 12.

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By employing at least one adjustable spacer element that takes effect between the outer panel element and the support element, final manufacturing tolerances or a possibly not 100% aligned installation of the support element is compensated. Preferably, a settable plastic that is applied in the not-yet set state to the support element, the outer panel element or a possible stiffening element of sufficient material strength is used as the spacer element. If the outer panel element is now moved towards the support element with the support element already installed in the chassis then, shortly before it reaches the desired installation position, the settable plastic comes into contact with the

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respective opposite component. The outer panel element is then moved into its desired final position, in which the peripheral gaps and the flushness exhibit the desired values. Since the outer panel element, preferably already surface-treated in this state, can be extraordinarily light, simple, in particular, automatable, handling devices for moving, holding and adjusting the outer panel element can be used. After reaching the desired final position, the outer panel element is held in this position long enough for the plastic to set sufficiently and thus the desired final dimension is in a sense "frozen in." Any tolerances between outer panel and support element are thus compensated for by the resulting final dimension of the spacer element, in particular, the settable plastic.

However, pure mechanical means as telescopic means like spacer bushes, for instance, can be considered as spacer elements. These mechanical means include fastening means such as screws or the like, in order to fix the outer panel in the assembled state. Specifically, spacer elements being effective in two, preferably in three, directions of space are preferred. This can be easily achieved by spacer elements made from settable plastic.

It is particularly preferable for the spacer element to also take on a fastening function. With settable plastic as a spacer element, therefore, an adhesion can also be brought about, if desired.

Heat-sensitive spacer elements as thermoplasts or hot-melt-type adhesive allow a readjusting and/or disengageable connection of the outer panel with the support element or the stiffening element. Heating means for readjusting the heat-sensitive spacer elements or disengaging the outer panel can be placed nearby the heat-sensitive spacer elements as well as can be integrated into the vehicle door.

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The outer panel element can be kept very thin-walled, so that it is very flexible

in the initial assembly. Likewise, the support element as such can be designed with respect to its stiffness such that this stiffness does not suffice by itself for the finished vehicle door. In the first case as well as in the second case, and also if both cases apply, the ultimately desired stiffness can be achieved by at least one, and preferably several, elongated stiffening elements, preferably linked together in the form of a frame, for the outer panel element and/or the support element. To this end, the stiffening element is preferably provided in the peripheral area of the service opening.

10 If such a stiffening element can be detachably joined to the support element, this has the effect, first of all, that the stiffening element can already be joined to the support element while setting the support element in the chassis, that is to say, its weight is taken into account during alignment and its stiffening effect is exerted on the support element. If in this case the outer panel element is joined to the stiffening element during the later closing of the service opening essentially to maintain a spacing, then the contact surface between stiffening element and support element serves as a later separation plane in case of maintenance work or the like on the functional parts of the door that may be necessary. Since the stiffening element is joined to the outer panel element in this case in a manner that fits - the specific door opening - perfectly, the stiffening element constitutes a structural unit with the outer panel element after initial assembly. Due to the detachability of the stiffening element from the support element, then, this component can later be removed as a complete assembly, with the stiffening element providing the relatively thin-walled outer panel element with sufficient stiffness that, even under shop conditions, an exposure of the service opening and subsequent reclosure is possible without problems.

30 The support element equipped with all functional parts can be inserted into the chassis and connected to it before the outer panel is applied. The equipping of the support element with functional parts can also take place before and/or

after fastening the support element to the chassis and an alignment of the support element with respect to the chassis can be carried out in a single work sequence without opening and again closing the support element. The adjustment of the support element can be accomplished with the aid of  
5 assembly blocks known from other fields, which indicate the final dimensions reached after the later placement of the outer panel element. The connecting of the support element with the outer panel element can take place in various ways, for instance, by blind bolting (bolting from the inside) and/or by glueing together.

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The aforementioned components to be used according to the invention, as well as those claimed and described in the embodiments, are not subject to any special requirements regarding their size, shaping, material selection or technical conception, so that the selection criteria familiar in the respective  
15 field of application can be applied without restriction within the scope of the claims.

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Additional details, characteristics and advantages of the object of the invention result from the subordinate claims as well as the description below of the  
20 associated drawing in which, for the sake of example, preferred embodiments of the vehicle door are presented. Shown in the drawing are:

Figure 1 a vehicle with the driver-side door, partially in an exploded view;

25 Figure 2 a passenger-side door for the same vehicle, partially in an exploded view;

Figure 3A the vehicle door of Figure 1 in a horizontal sectional representation (in part) - section along the line IIIA-III A according  
30 to Figure 1;

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Figure 3B an additional horizontal section (in part) of the same vehicle door-section along line IIIB-IIIB according to Figure 1;

5      Figure 4 a vertical sectional view of the door of Figure 1 or Figure 2 in the sill area with a raised window pane;

Figure 5 an alternative embodiment of a vehicle door in vertical section through the lower area (rocker panel area);

10     Figure 6 a vehicle door with mechanical spacer elements being effective in three dimensions of space;

Figure 7 a vehicle door with a integrated disassembling device.

*a* **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

15     As is best seen from Figure 2, a vehicle door, here a passenger door, has a support element 12 of sheet metal, which is designed as a deep-drawn part and is essentially free of openings, or in which any openings can be tightly covered, in order to obtain a dry space for electrical components on the vehicle interior side of support element 12. This inner side is covered by a conventional interior panel element 16, made of plastic, for instance. As is further evident from Figures 1 and 2, the outer panel element 14 represents an independent component, which is put in place on the support element from the outside only after the installation of the preferably already completely equipped support element 12 in the vehicle chassis and after alignment has been performed. As is additionally visible from Figure 1, various functional parts such as hinges 18, a closure element 20, a side-impact beam 30 and stiffening elements 24 are accessible on the outside 12A of the support element 12.

30     In order that the vehicle door can be initially installed in the vehicle chassis without an outer panel element 14 and aligned there, the support element 12 has a large service opening 22, which is surrounded by a frame-shaped

stiffening element 24, on its outer side 12A.

As is evident from Figures 3A-5 in detail, the stiffening element 24 consists of an essentially frame-shaped structure whose spanned area corresponds  
5 roughly to the opaque part of the door, that is, the part not having a window pane. In the area of the A-pillar, the B-pillar and for the C-pillar of the vehicle, as well as in the rocker panel area (Figure 5), the stiffening element 24 consists of a tube of roughly trapezoidal cross section. The sill area (Figure 4) consists of a so-called shaft reinforcement 24'. In the corner areas, the four  
10 stiffening elements 24, 24' are rigidly connected, not shown in further detail.

According to Figure 3A and Figure 3B the stiffening element 24 has a continuous sealing surface 24A, with which it can be joined to the outer panel element 14 in the edge area 14A. An adjustable-thickness spacer element 26 of hardenable plastic, in particular of a heat-sensitive plastic, reversible as a hot-melt-type adhesive, is used for this joint. The stiffening element 24, moreover, can be detachably bolted to the support element 12 from the inside with bolts 32. During the setting and alignment of the support element in the vehicle chassis, the stiffening element 24 is already firmly bolted to the support  
20 element 12, while the outer panel element 14 is still absent. Conventional alignment screws for the door are accessible from the outside through the service opening 22. After the end of this alignment process, the outer panel element 14, which is an already finish-painted deep-drawn piece of, for instance, sheet metal, provided with angled flanges 14B, is moved up to the  
25 stiffening element 14 with conventionally known handling equipment. Previously, the outside of the stiffening element 24 or the inside of the outer panel element 14 in the area of the edges is continuously coated, at least in the area of A-, B- and/or C-pillars and the rocker panel with overdimension, with not-yet reacted and sufficiently thixotropic adhesive with filling and sealing  
30 characteristics. After the outer panel element 14 has been brought into its final position shown in Figure 3A, it is held there for sufficient time for the plastic

that constitutes the spacing element 26 to adequately harden. Thus, the vehicle door 10 is closed off water-tight against the outside. In case of repairs, the bolts 32 must be loosened from the inside and the spacing element 26 cut free at its narrow contact face with the support element 12 in order to be able  
5 to remove the outer panel element 14 together with the stiffening elements 24.

A side-impact beam 30, as shown in Figure 3B, can be fastened to the support element 12 by means of angle brackets 30A without any resulting physical contact with the outer panel element 14. The side-impact beam 30, however,  
10 can equally well be joined in a precisely fitted manner to the outer panel element 14 by additional spacing elements 26, in the same manner as the stiffening element 24. In the rocker panel area, inclined run-off surfaces 26A of the spacing element 26 ensure that any condensate or penetrating water can run off via known drainage holes 34.

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Fig. 6 shows the embodiment of Fig. 3A - with exception of the spacing element, which exists of two or three mechanical spacer means 26D in Fig. 6, being of adjustable and fixable length.

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Fig. 7 shows the embodiment of Fig. 3B - with exception of the spacing element, which exists of a heat-sensitive spacer element 26B in Fig. 7, being made of a heat-sensitive plastic material like a hot-melt or thermoplastic resin. An, e.g. electrically operated, heating means 26D being closely positioned with respect to the heat-sensitive spacer element 26B, allows to detach the outer panel element 14 upon heating action by heating means 26D. - This device and method for disassembling structural or functional parts may be advantageously used in various other applications, particularly in the field of vehicle building and is - insofar - of own valuable technical meaning - even independently from the invention claimed in Claim 1.

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List of reference numerals

10      Vehicle door  
12      Support element  
5      12A      Outside  
14      Outer panel element  
14A      Edge zone  
14B      Flanges  
16      Interior panel element  
10      18      Hinge  
20      Closure element  
22      Service opening  
24      Stiffening element  
24'      Shaft reinforcement  
15      24A      Sealing surface  
26B      Heat-sensitive spacer elements  
26C      Heating means  
26D      Mechanical spacer means  
26      Spacing element  
20      26A      Run-off surfaces  
28      Hollow chamber  
30      Side-impact beam  
30A      Angle brackets  
32      Bolts  
25      34      Drainage holes  
36      Window pane